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ABSTRACT

Researchers have concluded that the continued debate over the heredity-environment issue concerning the nature of intelligence is nonproductive. Recent evidence demonstrates that intellectual abilities can be improved with practice. Heredity may determine upper limits of abilities within individuals, but there is considerable room left for improvement with practice. The Guilford model of intelligence suggests that intelligence is a systematic collection of functions for processing information. The most important intellectual skill that an individual can master is the discovery of the processes surrounding successful problem solving. A research design was implemented to apply the concept of intelligence as a series of teachable skills in a classroom setting. The subjects were 89 ninth grade students selected on the basis of low achievement scores. Pretest posttest results indicate that the adolescents' intellectual skills are capable of improvement in a relatively short period of time. (JN)

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COLLABORATIVE RESEARCH STUDY OF THE DEANS' COUNCIL

INCREASING ADOLESCENTS' INTELLECTUAL SKILLS

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INCREASING ADOLESCENTS' INTELLECTUAL SKILLS

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INTRODUCTION

Advances have been made over the past few decades in our conceptions of intelligence and intelligence tests. These innovations are beginning to be reflected in the field of education (Resnick, 1976).

In his book The Challenge of Incompetence and Poverty (1969), Hunt summarized several of these new beliefs: "...it is no longer tenable to conceive of intelligence tests as indicators of fixed capacity or innate potential.... It is untenable to consider tests of intelligence as fundamentally different from, or even very different from, tests of achievement.... It is semantically unfortunate to speak of intelligence as a dimension of persons and to speak of tests as scales." (p. 13)

Some researchers have concluded that continued debate over the heredity-environment issue is a nonproductive strategy. They reason that even if it were possible to determine precisely how much influence heredity and environment have upon an individual's intellectual capacity or performance, this knowledge would not be useful from an instructional point of view. A more

JUL 2 9 1980

fruitful research question is emerging; that of how educators can best arrange the environment to bring about optimal intellectual development in individual students. (Resnick, 1976).

Guilford (1979) recently noted that "the multitude of evidence that intellectual abilities can be improved with practice gives much reason to be optimistic." (p. 42) He reminds educators that "heredity may determine upper limits of abilities within individuals but there seems generally to be considerable room left for improvement with practice." (P. 42)

In his book Intelligence Can Be Taught, Whimbey (1975) has argued that intelligence is a skill that can be taught. He has challenged educators to explore the possibilities for training basic thinking strategies. He has pointed out that "as it becomes clear that intelligence is a teachable skill, the need for improved methods of training that skill should become clear to all." (p. 69)

Some researchers and educators are attempting to bridge the gap between the recent advances in our knowledge about intelligence and educational practice. Guilford (1979) has offered his Structure-of-Intellect (SI) model of intelligence as a rich source of the content that would be required for programs designed to foster intellectual growth. He suggests that, from the SI point of view, intelligence is a systematic collection of functions for processing information, functions

which can be developed through either direct or indirect educational approaches. He also summarizes a number of studies which used the SI model to enhance students' intellectual skills.

Educators are becoming aware that one critical aspect of intellectual functioning is problem-solving ability. According to Gagne'(1977), the most important intellectual skill that an individual can master is the discovery of the higher order rules needed for successful problem solving

Various models of problem-solving processes have been developed and utilized in educational programs. For example, Feldhusan and his colleagues have developed an instructional model based on twelve aspects of problem solving which they have identified (Hautz & Feldhusan, 1976). They have also developed a training program to teach creative problem solving, based on a five step process (Feldhusan & Guthrie, 1979). In experimental evaluations, both of these models were successful in improving students' problem-solving skills.

Parnes, Noller & Biondi (1979) have authored the Guide to Creative Action, a training manual describing their theory of creative problem solving as well as procedures for teaching the model.

Hobbs (1980) has reported on a program developed by Feuerstein to teach problem-solving skills to adolescents. The program is based on a series of exercises to help students develop problem-solving strategies which they can transfer to a variety of other situations.

Several researchers have suggested specific techniques for educators to use in helping students to strengthen their intellectual skills. (Gagne' (1977) has advised educators to use their feelings and hunches in problem solving situations. He also suggests that problem-solving sessions take place in groups, where most problem-solving activity emanates in our society. Finally, he maintains that problem solving should involve the constructive resolution of conflict.

Davis (1973) has emphasized that a student's attitudes about his ability to solve problems, his awareness of the importance of the problem situation, and his disposition to view a problem as solvable are crucial factors in determing his success in developing problem-solving strategies.

Whimbey & Lockhead (1979) developed a student workbook designed to assist in increasing successful problem solving by studying the strageties used by those who have been identified as good problem solvers.

Sager and Marr (1978) have developed a Cognitive Skills Manual, based on many of Whimbey's concepts. The manual, developed for teachers, presents a series of training exercises designed to develop students' abilities in the following: Thinkmaking, the ability to develop mental images; Qualification, the ability to focus on aspects or characteristics of things; Seeing Analogies, the ability to think relationally; Classification, the ability to "sort" information; Structure Analysis, the ability to think in terms of "wholes and parts";

and Operation Analysis, the ability to analyze information utilizing the factor of time.

In summary, advances in our understanding of intelligence and intelligence tests are being reflected in an increasing interest in the development and utilization of instructional materials to enhance students' intellectual skills.

STATEMENT OF THE PROBLEM

The main purpose of the present study was to design a preliminary project aimed at applying the concept of intelligence as a series of teachable skills to a classroom setting. Specifically, this preliminary project attempted to increase adolescent students' intellectual abilities, as measured by a cognitive skills test, by utilizing a series of instructional materials adapted from Sager & Marr's Cognitive Skills Manual.

METHOD

Subjects

The subjects of this study were 89 ninth grade students enrolled in five sections of physics classes for underachievers in a public high school in Hartford, CT. The students had been selected for these classes on the basis of low achievement scores in either mathematics or reading, coupled with indications of achievement potentials such as good attendance records and the absence of emotional problems.

Procedures

The students were adminstered the Verbal and Nonverbal subtests of the Cognitive Abilities Test (CAT), Form F., in both December, 1979, and May, 1980, to obtain pre- and post-test measures of their levels of intellectual functioning. The entire CAT was not administered due to time restraints.

For the five months between the testing dates, the students were exposed to a series of thinking skills exercises based on Sager and Marr's Cognitive Skills Manual, adapted to the physics curriculum utilized in the classes. The exercises were composed of activities designed to promote the thinking skills identified by Sager and Marr (1978) and listed above. These exercises were changed to emphasize the concepts and skills being presented in the physics classes.[1] The exercises were presented to the students in two forms; they were incorporated into the instructional activities of the classroom for approximately 40 minutes per week, and they were included in the students' weekly homework assignments.

RESULTS AND DISCUSSION

The analyses of the students' scores on the pre- and post-tests of the CAT are presented in Table 1. Due to some absences during the testing sessions, the number of students for whom both test scores were available was reduced to 66 for the Verbal subtest and 63 for the Nonverbal subtest.

Table 1

Comparison of Means and Standard Deviations for Pre- and Posttest of the Verbal and Nonverbal Subtests of the CAT

Test		N	Mean	SD	df	t	p
Verbal Subtest	Pretest	66	53.05	6.59	65	8.64	.001
	Posttest		58.41	7.94			
Nonverbal Subtest	Pretest	63	51.60	9.06	62	8.71	.001
	Posttest		56.70	10.28			

As indicated in Table 1, the student's scores were significantly higher in the posttest for both the Verbal and Nonverbal measures of the CAT than they were in the pretest.

These results suggest that adolescents' intellectual skills, as measured by the CAT, are capable of improvement and that this improvement can take place over a relatively short period of time, as was the case in this study. The findings lend support to the growing body of literature which indicates that intelligence tests are not fundamentally different from achievement tests and that intellectual skills can be enhanced by instructional intervention (Guilford, 1979; Hunt, 1969; Whimbey, 1975).

One limitation of the present study was its lack of attention to the possible significance of several variables that were operating at the time of the study. For example, the adaptation of the thinking skills exercises to physics, a core subject in the students' schedule, may have increased the students' assessment of the value of the exercises. Students' realization of the value of problem-solving activities has been identified as an important factor in the development of these cognitive skills (David, 1973).

The instructor's enthusiasm for the project and her expectation that her students would improve with effort and support, may have raised the students' confidence in their abilities. This factor has also been related to improved thinking skills (David, 1973).

Another limitation of the study is the lack of a control group. There is a possibility that some of the increase in scores could be attributed to the effect of practice. The pre- and posttests were administered five months apart, but only one form of the test was available for both testing dates. The manual for the CAT reports a reliability coefficient for Form F, ninth grade, of .939 for the Verbal subtest and .928 for the Nonverbal. However, these correlations are coefficients of internal consistency. No coefficients of stability were reported for the CAT.

An attempt will be made to correct these limitations in a replication study to begin next fall.

[1] A sample set of the exercises are available upon request from: The Hartford Public Schools/University of Hartford Teacher Corps Project, H-128, University of Hartford, 200 Bloomfield Avenue, West Hartford, CT 06117.

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